

Field of the Invention

Background of the Invention

[0003] Within the mobile data device, a windows-type operating system is often provided. A graphical users interface (GUI) may be provided to reduce the need for external control keys and keyboards.

[0005] It can be difficult for service providers to offer Internet services to cellular based mobile data devices. There are a number of reasons for this difficulty.

For example, the cellular telephone system and the Internet are fundamentally different environments. Protocols and hardware developed for one environment and not necessarily compatible with the other.

[0006] As data service is currently offered for mobile data devices, a user purchases the device and subscribes for service with a local wireless provider. When the device requests service, the local wireless provider tests whether the user has paid an access charge. If the access charge has been paid, the device is allowed access to the Internet.

[0007] In the past, carrier grade services have been offered using specialized hardware equipment for use by the service provider. Because of the inflexibility of the specialized hardware solutions, it has been difficult to modify the existing hardware platforms to offer wireless data services, including specialized user level services, menu options, new forms of user authorization and authentication, efficiency optimizations, and content based billing to the existing apparatus for providing carrier grade services.

Summary of the Invention

[0008] A method and apparatus are described for providing data services to a mobile data device through a packet data service node system and a wireless data network. The method includes the steps of exchanging data between the mobile data device and packet data service node system at least partially through the wireless data network using a tunneling protocol, decoding the tunneling protocol within a programmers space of a general purpose computing platform of the packet data service node system, determining an identity of the user from the decoded tunneling protocol and

and also to any other wireless device that has the data access, retrieval and display capabilities of a conventional PDA (e.g., appropriately equipped cellular telephones or pagers, personal computers with wireless interfaces, etc.).

[0019] Further, while the PDSN system 10 will be described in terms of cellular services offered within the U.S., it is to be understood that the PDSN system 10 may also be implemented within the cellular systems of other countries (e.g., GSM in Europe, JTACS in Japan, etc.). For example, GGSN is an equivalent packet data services network used in conjunction with GSM. GTP is a GSM tunneling protocol supporting end-to-end processes similar to those described below. It is to be understood that the descriptive terms used herein are intended to include the corresponding processes and structure of the cellular systems of other countries.

[0020] To access data services within the U.S. cellular system, a MDD (e.g. 16) may activate on ON softkey 64 (FIG. 3) on a screen 50 of the MDD 16. In response, a central processing unit CPU 80 (FIG. 5) within the MDD 16 may activate the transceiver 84 and search for a control channel of a local base station (BS) 20.

[0021] Upon locating a control channel, the CPU 80 may compose an access request. The access request may be transferred to the transmitter 84 and be transmitted to the base station (BS) 20. The access request may include an identifier of the MDD 16 (e.g., a MIN number, IMSI number, etc.).

[0022] The BS 20 may respond with an acknowledgement including a randomly generated call identifier. The call identifier may be used by the MDD 16 and BS 20 as a pseudo-address to identify subsequent transmissions between the BS 20 and the MDD 16.

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[0023] The BS 20 may also transfer the request to a local radio node (RN) 24. The RN 24 may recognize from the identifier of the MDD 16 that the access request is for data services and may transfer the request to an associated PDSN node 12.

[0024] In order to facilitate transfer of the access request to the PDSN 12, the RN 24 may set up a RN/PDSN data link between the RN 24 and PDSN node 12 based upon an appropriate protocol (e.g., Generic Routing Encapsulation (GRE)). GRE is a protocol which allows an arbitrary network protocol A to be transmitted over any other arbitrary network protocol B, by encapsulating the packets of A within GRE packets, which in turn are contained within packets of B. The use of GRE is described in RFC 1701 and RFC 1702 by the Internet Engineering Task Force (IETF) in the context of GRE over IP.

[0025] In addition to allowing the exchange of data between the RN 24 and PDSN node 12, the RN/PDSN data link may also support the use of tunneling protocols between the PDSN node 12 and MDDs 16, 18. The tunneling link provides a mechanism for transporting multi-protocols datagrams between the PDSN and MDD.

[0026] As used herein, the packets of protocol A processed for transmission over the RN/PDSN data link may be supplied under the tunneling protocol (e.g., a Point to Point Protocol (PPP)) established by the PDSN node 12 with the MDD 16 through the RN 24. The packets of B may be IP. The format of PPP encapsulated in GRE, encapsulated in IP is referred to as a PPP over GRE over IP protocol.

[0027] PPP includes at least three components: 1) a method of encapsulating datagrams; 2) a link control protocol (LCP) for establishing, configuring and testing the data-link connection and 3) a family of network control

protocols (NCPs) for establishing and configuring different network-layer protocols. PPP is described in RFC 1661.

[0028] To form the RN/PDSN data link, the RN 24 may transmit a setup instruction from a data link code plug of the RN 24 to a corresponding data link code plug of the PDSN 12. For purposes of explanation, a data link CODEC application 96 of the RN 24 and a data link CODEC application 154 of the PDSN 12 may be regarded as the corresponding set of data link code plugs. The data link CODECS 96, 154 may be used both for setup of the RN/PDSN data link and also for decoding RN/PDSN data link packets 110 (FIG. 8).

[0029] To set up the RN/PDSN data link, the data link CODEC 96 may retrieve a default address 101 of the corresponding data link CODEC 154 from a memory 100 of the RN 24. Upon retrieving an address, the data link CODEC 96 may compose a setup request and send it to the PDSN 12.

[0030] Within the PDSN 12, a router 158 may decode a header of the setup request, recover the address 101 of the data link CODEC application 154, and route the setup request to the data link CODEC application 154. Within the data link CODEC application 154, the setup request may be decoded and send to a processing application (e.g., application #1 162).

[0031] The application 162 may, in turn, activate a tunneling CODEC application 156. As with the RN/PDSN data link, the tunneling CODEC 156 of the PDSN 12 may represent a first tunneling code plug and the tunneling CODEC 98 of the RN 24 (FIG. 6) may represent a corresponding second tunneling code plug.

[0032] Upon activation of the corresponding sets of data link code plugs and tunneling code plugs, a RN/PDSN data link may be set up between the RN 24 and PDSN 12.

Similarly, a tunneling link may be set up between the PDSN 12 and MDD 16.

[0033] In general, the data and tunneling links provide communication channels that are transparent to the respective devices. The tunneling link may be used by the PDSN 14 to receive communications requests from the MDD 16 and to download data to the MDD 16. The RN/PDSN data link may be used to support of the tunneling link and also to exchange control and billing information between the RN 24 and PDSN 12.

[0034] As discussed in more detail below, the application 162 may function through the data and tunneling links to provide authentication/authorization (AA) features directed to identification of the MDD 16. The application 162 may also provide data services to the MDD 16 under control of a user profile (e.g., UP #1 168). In effect, the application 162 may provide user services to the user of the MDD 16 based upon the services selected and subscribed to by the user. To provide the selected services, the application 162 may function as a buffer between the MDD 16 and the Internet 34.

[0035] By placing the application 162 within the PDSN 12, instead of within the MDD 16, data traffic across the wireless interface may be reduced. Further, by placing the application 162 within the system 10 (instead of within the MDD 16), data services provided to the MDD 16 may be specifically tailored to the user. Further, billing entries for optional or incremental services may be made based upon the user's identify and upon use.

[0036] In general, the system 10 may be implemented within a programmers space of a general purpose computing platform 12, 14. Implementing the system 10 within the

[0045] To encode the data request for transmission across the wireless interface, the CPU 80 may send the request to an Internet Protocol (IP) coder/decoder (CODEC) 86. The IP CODEC 86 may encode the request as an IP packet 102 (FIG. 7).

[0046] As shown in FIG. 7, an IP packet 102 may include a header 104, data 106 and an end 108. The type of request, user name and system identifier may be included within the data section 106. The header of the IP packet 102 may be a packet destination. In this case, the address used for the header 104 may be the user datagram protocol (UDP) of a user service application 162, 164 within the PDSN 12. The end section 108 may include any of a number of possible end bits (e.g., parity coding, CRC, etc.).

[0047] Once the CODEC 86 has encoded the IP packet 102, the IP CODEC may transfer the IP packet 102 to the transceiver 84. The transceiver 84 may transmit the IP packet to the BS 20 through the antenna 42. The BS 20 may, in turn, forward the IP packet 102 to the RN 24.

[0048] Within the RN 24, 26, the IP packet 102 may be encoded within the data link CODEC 96 into a RN/PDSN data link packet 110 (FIG. 8). A header 112 of the RN/PDSN data link packet 110 may include an address of the corresponding data link CODEC 154 of the PDSN 12, 14. The data section 114 may include the IP packet 102.

[0049] The data link packet 110 in turn may be encoded as a tunneling packet 120. As above, a header 122 of the tunneling packet 120 may include an address of the corresponding tunneling CODEC 156 of the PDSN 12, 14. The data section 114 may include the data link packet 110.

[0050] At the same time that the application returns the access grant to the authorized user, the application 162 may access a user profile 168 of the authorized user to

[0055] Alternatively, the user may activate a SEARCH key 54. In this case, the application 162 may retrieve a URL 176, 178 of its own search engine 180, either within the PDSN 12, 14 or at some other predetermined location on the Internet. Where the application 162 takes the user to its own search engine, the web page 70 (FIG. 4) may be provided to the user on the user's MDD 16, 18 for entry of search terms. The user may enter search terms appearing in a window 72 using a keyboard 74.

[0056] To protect the application 162 (and/or the search engine 180), inquiries directed to external servers through the Internet may be directed through a web proxy server 190 operating from within a firewall 191. The proxy server 190 may protect internal clients by performing network address translation. The proxy server 190 may listen for requests from clients on the protected side of the firewall 191 and forward these requests to remote Internet servers outside the firewall using its own address as a return address. When a response is received, the proxy server 190 reads the response from the external servers, matches it with the original request and then sends it to the internal client.

[0057] Further, the web proxy 190 may function to store frequently accessed documents in a web cache 196. An entire workgroup of applications 162, 164 may be configured to use the cache of documents 196. This reduces loading on the proxy server 190 by allowing the applications 162, 164 to retrieve documents from the cache 196 for retransmission to MDDs when responding to subsequent requests.

[0058] Parental controls may also be implemented within the application 162, 164 or within the web proxy 190. In either case, a set of filters 194 may be provided identifying various levels of parental control based upon

174. At the end of the billing period, the user may be invoiced for each search or for searches above some threshold level.

[0063] Alternatively, if the user has paid for such services, then the user may access the Internet through the proxy server 190, or directly, either by activation of the INTERNET key 59 or by activating the KEYBOARD key 68. In either case, the keyboard 70 (FIG. 4) may be downloaded to the MDD 16, 18. The user may enter a search term (or website) displayed in a window 72 by using the keyboard 74.

[0064] In either case, the browser may be located in the application 162, instead of the MDD 16. Locating the browser in the application 162 reduces the intelligence necessary within the MDD 16. Locating the browser in the application 162 further reduces the data volume across the wireless interface and allows the MDD 16 to function simply as a graphical user interface.

[0065] In a similar manner, the user may activate an E-MAIL key 58. In response, the application 162 may retrieve a URL 176, 178 of the user's e-mail server 42. Upon accessing the server 42, the application 162 may receive and download a summary of the user's e-mail file. Once the user's file has been accessed, individual e-mails may be retrieved and read using methods well known in the art. As the user downloads each e-mail, the billing file 172, 174 may be updated accordingly by a billing processor 182.

[0066] The processing of data requests within the programmers space allows great flexibility in the processing and tracking of access requests. The ability to redirect http and wireless application protocol (WAP) requests to specialized search engines 180 allows the billing processor 182 to analyze and measure the content and scope of each

access request. The ability to measure the scope and content of access requests provides a significant advantage in terms of the ability to relate use to cost.

[0067] In addition to the multitude of services that become available, the PDSN system 10 also provides a significant increase in data transfer efficiency between Internet resources and the MDD. For example, the PSDN system 10 has the ability to channel code the TCP protocol to maximize throughput from an information theory point of view and from a networking point of view.

[0068] As mentioned above, cellular telephone system and the Internet are fundamentally different environments. The wireless path between the base station and the cellular receiver is subject to any number of different data transfer obstacles (e.g., random interference, multipath interference, signal fading, signal blocking, etc.). In order to improve the reliability of the radio link, the data is, in most cases, transferred slower and in smaller increments.

[0069] Further, the loss of small amounts of voice data is not critical to understanding a conversation. As a result, error correction and detection are not usually necessary over the wireless link.

[0070] In contrast, data transferred through the Internet is transferred at a relatively high rate of speed in relatively large blocks. Once a block is transferred, the sender may wait for an acknowledgement.

[0071] When the data transfer characteristics of the Internet are applied to MDDs, the result is less than satisfactory. When a large block of data is transferred, the loss of only a small part of the block requires the retransmission of the entire block. Further, in the case of a web site transmission, the acknowledgement of receipt of a

block must pass from the MDD all the way to the website before the next block may be transferred.

[0072] To reduce the difficulties associated with transmission of information to the MDD 16, 18, the PDSN system 10 may reformat information passing between the two systems. A transcoder 188 and cache memory 186 may be provided within the TUNNELING CODEC 156 to locally store large blocks (web pages) or small blocks (e.g., TCP packets) received from the Internet side of the tunneling CODEC 156. The transcoder 188 may function to return acknowledgements to the sender for information traveling in either direction.

[0073] The caching of packets in cache memory 186 within the PDSN 10 allows the transcoder 188 to break up large packets into small packets for transmission across the wireless interface. Where a packet is lost, it may be recovered from the local cache 186, thereby reducing time and eliminating the need to retransmit a large block of information from a remote web site.

[0074] Further, the transcoder 186 may also provide error correction and control from within the tunneling CODEC 156. Such error correction and control may be implemented under any of a number of different formats (e.g., parity, CRC, etc.). Since correction and control is accomplished from within the PDSN system 10, the traffic associated with such correction and control is localized to the area between the MDD and PDSN 10.

[0075] The transcoder 186 also allows for the use of flow control within the system 10. As large packets are received, the transcoder 186 may defer returning an acknowledgement until the large packet has been processed into small packets and the MDD has acknowledged receipt of each of the small packets. Flow control may be used to reduce a size of the cache memory 186 within the PDSN 10.

[0076] The transcoder 186 may also automatically adjust retransmit times to the specifics of the associated cellular system. Since cellular systems are inherently slower than the Internet, the automatic adjustment of retransmit times substantially reduces the need for unnecessary retransmissions, thereby further reducing unnecessary traffic.

[0077] A specific embodiment of a method and apparatus for providing a wireless data access infrastructure based upon an open architecture has been described for the purpose of illustrating the manner in which the invention is made and used. It should be understood that the implementation of other variations and modifications of the invention and its various aspects will be apparent to one skilled in the art, and that the invention is not limited by the specific embodiments described. Therefore, it is contemplated to cover the present invention and any and all modifications, variations, or equivalents that fall within the true spirit and scope of the basic underlying principles disclosed and claimed herein.